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(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization  
International Bureau



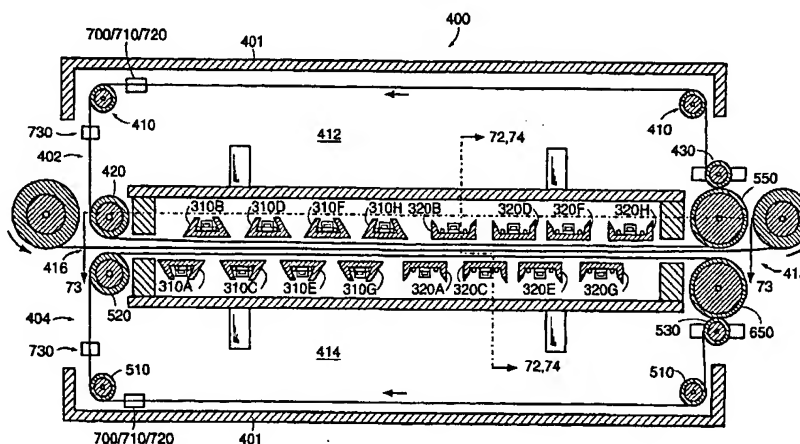
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60/155,364 20 September 1999 (20.09.1999) US
- (71) Applicant (for all designated States except US): HUNTER DOUGLAS INC. [US/US]; 2 Park Way, Upper Saddle River, NJ 07458-0740 (US).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): COLSON, Wendell, B. [US/US]; 12 Tech Circle, Natick, MA 01760 (US). DANN, Kevin [US/US]; 12 Tech Circle, Natick, MA 01760 (US).
- (74) Agents: LINEK, Ernest, V. et al.; Banner & Witcoff, Ltd., 28 State Street, 28th floor, Boston, MA 02109 (US).
- (81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.
- (84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).
- Published:  
— With international search report.  
— Before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments.
- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: PRESSURE LAMINATOR APPARATUS AND NON-WOVEN FABRIC FORMED THEREBY



(57) Abstract: This invention relates to a lamination apparatus and in particular to a dual belt driven, continuous pressure lamination apparatus that utilizes pressure, heat and cooling to bond at least two substrates (plies) with an adhesive between the layers of the substrates. The pressure laminator of the present invention has been specifically designed to permit the permanent joining of at least two fabric substrates with an adhesive between the fabric substrates, with little or no shrinkage occurring during the lamination process. The resulting non-woven fabric advantageously has the appearance of a woven fabric, but has superior strength characteristics there over. The pressure laminator of the present invention can have other uses, for example, printed circuit board substrate manufacture, and the like, as will be appreciated by those having ordinary skill in this art.

WO 01/21399 A1

# PATENT COOPERATION TREATY

# PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>4686/00002</b>	<b>FOR FURTHER ACTION</b>		see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
International application No. <b>PCT/US 00/ 25680</b>	International filing date (day/month/year) <b>20/09/2000</b>	(Earliest) Priority Date (day/month/year) <b>20/09/1999</b>	
Applicant  <b>HUNTER DOUGLAS INC. et al.</b>			

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 03 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

**1. Basis of the report**

- a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).
- b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :
- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

- ☒ the text is approved as submitted by the applicant.
- ☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

- ☒ the text is approved as submitted by the applicant.
- ☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

- ☒ as suggested by the applicant.
- ☐ because the applicant failed to suggest a figure.
- ☐ because this figure better characterizes the invention.
- ☐ None of the figures.

# INTERNATIONAL SEARCH REPORT

<b>A. CLASSIFICATION OF SUBJECT MATTER</b> IPC 7 B32B31/00 B30B5/06 D04H3/04		International Application No <b>PCT/US 00/25680</b>
According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b> Minimum documentation searched (classification system followed by classification symbols) IPC 7 B32B B30B D04H B29C		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practical, search terms used) EPO-Internal, WPI Data, PAJ		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 01 210318 A (MITSUBISHI RAYON ENG CO LTD) 23 August 1989 (1989-08-23) figures	1, 16, 18
X	& PATENT ABSTRACTS OF JAPAN vol. 013, no. 519 (M-895), 20 November 1989 (1989-11-20) & JP 01 210318 A (MITSUBISHI RAYON ENG CO LTD), 23 August 1989 (1989-08-23) abstract <div style="text-align: center;">--- -/-</div>	1, 16, 18
<div style="display: flex; justify-content: space-between;"> <span><input checked="" type="checkbox"/> Further documents are listed in the continuation of box C.</span> <span><input checked="" type="checkbox"/> Patent family members are listed in annex.</span> </div>		
<div style="display: flex;"> <div style="flex: 1;"> <p>* Special categories of cited documents:</p> <p>*A* document defining the general state of the art which is not considered to be of particular relevance</p> <p>*E* earlier document but published on or after the international filing date</p> <p>*L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>*O* document referring to an oral disclosure, use, exhibition or other means</p> <p>*P* document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="flex: 1;"> <p>*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>*Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>*G* document member of the same patent family</p> </div> </div>		
Date of the actual completion of the international search <div style="text-align: center;">22 January 2001</div>		Date of mailing of the international search report <div style="text-align: center;">08/02/2001</div>
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016		Authorized officer <div style="text-align: center;">Barathe, R</div>

# INTERNATIONAL SEARCH REPORT

In .ational Application No  
PCT/US 00/25680

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 63 267525 A (MITSUBISHI RAYON ENG CO LTD) 4 November 1988 (1988-11-04) figures	1,2,5,8, 12,18
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P,X	WO 00 41523 A (HUNTER DOUGLAS IND BV ;HARTMAN DAVID (US); SWISCZ PAUL (US); HUNTE) 20 July 2000 (2000-07-20) cited in the application claims 130-143; figures 71-77	1-18, 21-24
X	US 4 687 528 A (HELD KURT) 18 August 1987 (1987-08-18) column 6, line 27 - line 44; figures	1
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# INTERNATIONAL SEARCH REPORT

Information on patent family members

In International Application No

PCT/US 00/25680

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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# PCT

## REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

International Application No.

International Filing Date

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference  
(if desired) (12 characters maximum) 4686/00002**Box No. I TITLE OF INVENTION**

PRESSURE LAMINATOR APPARATUS AND NON-WOVEN FABRIC FORMED THEREBY

**Box No. II APPLICANT**

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

HUNTER DOUGLAS INC.  
2 Parkway  
Upper Saddle River, New Jersey 07458-0740  
United States of America

☐ This person is also inventor.

1-800-444-8844  
Telephone No.

1-201-327-5644  
Facsimile No.

Teleprinter No.

N/A

State (that is, country) of nationality: US

State (that is, country) of residence: US

This person is applicant ☒ all designated States ☐ all designated States except the United States of America  
for the purposes of: ☐ the United States of America only ☐ the States indicated in the Supplemental Box

**Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)**

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

COLSON, Wendell B.  
12 Tech Circle  
Natick, Massachusetts 01760  
United States of America

This person is:

☐ applicant only☒ applicant and inventor☐ inventor only (If this check-box is marked, do not fill in below.)

State (that is, country) of nationality: US

State (that is, country) of residence: US

This person is applicant ☐ all designated States ☐ all designated States except the United States of America  
for the purposes of: ☒ the United States of America only ☐ the States indicated in the Supplemental Box

☒ Further applicants and/or (further) inventors are indicated on a continuation sheet.**Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE**

The person identified below is hereby/has been appointed to act on behalf ☒ agent ☐ common representative  
of the applicant(s) before the competent International Authorities as:

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)

LINEK, Ernest V.  
BANNER & WITCOFF, LTD.  
28 State Street, 28th Floor  
Boston, Massachusetts 02109  
United States of America

Telephone No.  
(617)227-7111

Facsimile No.  
(617) 227-4399

Teleprinter No.  
N/A

☐ Address for correspondence: Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

**Continuation of Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTORS****If none of the following sub-boxes is used, this sheet should not be included in the request.**

Name and address: (Family name followed by given name; for a legal entity, full official designation.  
The address must include postal code and name of country. The country of the address indicated in this Box  
is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

DUNN, Kevin  
12 Tech Drive  
Natick, Massachusetts 01760  
United States of America

This person is:

☐ applicant only☒ applicant and inventor☐ inventor only (If this check-box  
is marked, do not fill in below.)

State (that is, country) of nationality: US

State (that is, country) of residence: US

This person is applicant ☐ all designated States ☐ all designated States except the United States of America  
for the purposes of: ☒ the United States of America only ☐ the States indicated in the Supplemental Box

Name and address: (Family name followed by given name; for a legal entity, full official designation.  
The address must include postal code and name of country. The country of the address indicated in this Box  
is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

This person is:

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is marked, do not fill in below.)

State (that is, country) of nationality:

State (that is, country) of residence:

This person is applicant ☐ all designated States ☐ all designated States except the United States of America  
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Name and address: (Family name followed by given name; for a legal entity, full official designation.  
The address must include postal code and name of country. The country of the address indicated in this Box  
is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

This person is:

☐ applicant only☐ applicant and inventor☐ inventor only (If this check-box  
is marked, do not fill in below.)

State (that is, country) of nationality:

State (that is, country) of residence:

This person is applicant ☐ all designated States ☐ all designated States except the United States of America  
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Name and address: (Family name followed by given name; for a legal entity, full official designation.  
The address must include postal code and name of country. The country of the address indicated in this Box  
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This person is:

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is marked, do not fill in below.)

State (that is, country) of nationality:

State (that is, country) of residence:

This person is applicant ☐ all designated States ☐ all designated States except the United States of America  
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## Box No.V DESIGNATION OF STATES

The following designations are hereby made under Rule 4.9(a) (mark the applicable check-boxes; at least one must be marked):

## Regional Patent

- ☒ AP ARIPO Patent: GH Ghana, GM Gambia, KE Kenya, LS Lesotho, MW Malawi, MZ Mozambique, SD Sudan, SL Sierra Leone, SZ Swaziland, TZ United Republic of Tanzania, UG Uganda, ZW Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT
- ☒ EA Eurasian Patent: AM Armenia, AZ Azerbaijan, BY Belarus, KG Kyrgyzstan, KZ Kazakhstan, MD Republic of Moldova, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT
- ☒ EP European Patent: AT Austria, BE Belgium, CH and LI Switzerland and Liechtenstein, CY Cyprus, DE Germany, DK Denmark, ES Spain, FI Finland, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT
- ☒ OA OAPI Patent: BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Côte d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, GW Guinea-Bissau, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT (if other kind of protection or treatment desired, specify on dotted line)

National Patent (if other kind of protection or treatment desired, specify on dotted line):

- |  |   |
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| <input checked="" type="checkbox"/> AE United Arab Emirates                  | <input checked="" type="checkbox"/> LC Saint Lucia  |
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| <input checked="" type="checkbox"/> AT Austria                               | <input checked="" type="checkbox"/> LT Lithuania  |
| <input checked="" type="checkbox"/> AU Australia                             | <input checked="" type="checkbox"/> LU Luxembourg   |
| <input checked="" type="checkbox"/> AZ Azerbaijan                            | <input checked="" type="checkbox"/> LV Latvia   |
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| <input checked="" type="checkbox"/> BG Bulgaria                              | <input checked="" type="checkbox"/> MG Madagascar   |
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| <input checked="" type="checkbox"/> CH and LI Switzerland and Liechtenstein  | <input checked="" type="checkbox"/> MZ Mozambique   |
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| <input checked="" type="checkbox"/> DE Germany                               | <input checked="" type="checkbox"/> RO Romania  |
| <input checked="" type="checkbox"/> DK Denmark                               | <input checked="" type="checkbox"/> RU Russian Federation   |
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| <input checked="" type="checkbox"/> GD Grenada                               | <input checked="" type="checkbox"/> TJ Tajikistan   |
| <input checked="" type="checkbox"/> GE Georgia                               | <input checked="" type="checkbox"/> TM Turkmenistan   |
| <input checked="" type="checkbox"/> GH Ghana                                 | <input checked="" type="checkbox"/> TR Turkey   |
| <input checked="" type="checkbox"/> GM Gambia                                | <input checked="" type="checkbox"/> TT Trinidad and Tobago  |
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| <input checked="" type="checkbox"/> JP Japan                                 | <input checked="" type="checkbox"/> YU Yugoslavia   |
| <input checked="" type="checkbox"/> KE Kenya                                 | <input checked="" type="checkbox"/> ZA South Africa   |
| <input checked="" type="checkbox"/> KG Kyrgyzstan                            | <input checked="" type="checkbox"/> ZW Zimbabwe   |
| <input checked="" type="checkbox"/> KP Democratic People's Republic of Korea | <input type="checkbox"/> Check-box reserved for designating States which have become party to the PCT after issuance of this sheet: |
| <input checked="" type="checkbox"/> KR Republic of Korea                     |   |
| <input checked="" type="checkbox"/> KZ Kazakhstan                            |   |

**Precautionary Designation Statement:** In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. (Confirmation (including fees) must reach the receiving Office within the 15-month time limit.)

**Supplemental Box**

If the Supplemental Box is not used, this sheet should be included in the request.

1. If, in any of the Boxes, the space is insufficient to furnish all the information: in such case, write "Continuation of Box No. ..." [indicate the number of the Box] and furnish the information in the same manner as required according to the captions of the Box in which the space was insufficient, in particular:

(i) if more than two persons are involved as applicants and/or inventors and no "continuation sheet" is available: in such case, write "Continuation of Box No. III" and indicate for each additional person the same type of information as required in Box No. III. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below;

(ii) if, in Box No. II or in any of the sub-boxes of Box No. III, the indication **"the States indicated in the Supplemental Box"** is checked: in such case, write "Continuation of Box No. II" or "Continuation of Box No. III" or "Continuation of Boxes No. II and No. III" (as the case may be), indicate the name of the applicant(s) involved and, next to (each) such name, the State(s) (and/or, where applicable, ARIPO, Eurasian, European or OAPI patent) for the purposes of which the named person is applicant;

(iii) if, in Box No. II or in any of the sub-boxes of Box No. III, the inventor or the inventor/applicant is not inventor for the purposes of all designated States or for the purposes of the United States of America: in such case, write "Continuation of Box No. II" or "Continuation of Box No. III" or "Continuation of Boxes No. II and No. III" (as the case may be), indicate the name of the inventor(s) and, next to (each) such name, the State(s) (and/or, where applicable, ARIPO, Eurasian, European or OAPI patent) for the purposes of which the named person is inventor;

(iv) if, in addition to the agent(s) indicated in Box No. IV, there are further agents: in such case, write "Continuation of Box No. IV" and indicate for each further agent the same type of information as required in Box No. IV;

(v) if, in Box No. V, the name of an State (or OAPI) is accompanied by the indication **"patent of addition,"** or **"certificate of addition,"** or if, in Box No. V, the name of the United States of America is accompanied by an indication **"continuation"** or **"continuation-in-part"**: in such case, write "Continuation of Box No. V" and the name of each State involved (or OAPI), and after the name of each such State (or OAPI), the number of the parent title or parent application and the date of grant of the parent title or filing of the parent application;

(vi) if, in Box No. VI, there are more than three earlier applications whose priority is claimed: in such case, write "Continuation of Box No. VI" and indicate for each additional earlier application the same type of information as required in Box No. VI;

(vii) if, in Box No. VI, the earlier application is an ARIPO application: in such case, write "Continuation of Box No. VI", specify the number of the item corresponding to that earlier application and indicate at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed.

2. If, with regard to the **precautionary designation statement** contained in Box No. V, the applicant wishes to exclude any State(s) from the scope of that statement: in such case, write "Designation(s) excluded from precautionary designation statement" and indicate the name or two-letter code of each State so excluded.

3. If the applicant claims, in respect of any designated Office, the benefits of provisions of the national law concerning **non-prejudicial disclosures or exceptions to lack of novelty**: in such case write "Statement concerning non-prejudicial disclosures or exceptions to lack of novelty" and furnish that statement below.

Continuation of Box No. IV:

MCDERMOTT, Peter J.  
IWANICKI, John P.  
COHAN, Gregory J.

All members of the firm of BANNER & WITCOFF, LTD. at the address, telephone and telefacsimile numbers as indicated in Box No. IV.

<b>Box No. VI PRIORITY CLAIM</b>		<input checked="" type="checkbox"/> Further priority claims are indicated in the Supplemental Box.		
		Where earlier application is:		
Filing date of earlier application (day/month/year)	Number of earlier application	national application: country	regional application:* regional Office	international application: receiving Office
item (1) 20/09/99	60/155,364	US		
item (2)				
item (3)				
<p><input checked="" type="checkbox"/> The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) (only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office) identified above as item(s): (1)</p> <p>* Where the earlier application is an ARIPO application, it is mandatory to indicate in the Supplemental Box at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed (Rule 4.10(b)(ii)). See Supplemental Box.</p>				
<b>Box No. VII INTERNATIONAL SEARCHING AUTHORITY</b>				
Choice of International Searching Authority (ISA) (if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used): <b>ISA/EPO</b>		Request to use results of earlier search; reference to that search (if an earlier search has been carried out by or requested from the International Searching Authority): Date (day/month/year)      Number      Country (or regional Office)		
<b>Box No. VIII CHECK LIST; LANGUAGE OF FILING</b>				
This international application contains the following number of sheets:  request : 5 sheets description (excluding sequence listing part) : 14 sheets claims : 3 sheets abstract : 1 sheet drawings : 7 sheets sequence listing part of description : sheets Total number of sheets : 30 sheets		This international application is accompanied by the item(s) marked below: 1. <input checked="" type="checkbox"/> fee calculation sheet (duplicate) 2. <input type="checkbox"/> separate signed power of attorney 3. <input type="checkbox"/> copy of general power of attorney; reference number, if any: 4. <input type="checkbox"/> statement explaining lack of signature 5. <input type="checkbox"/> priority document(s) identified in Box No. VI as item(s): 6. <input type="checkbox"/> translation of international application into (language): 7. <input type="checkbox"/> separate indications concerning deposited microorganism or other biological material 8. <input type="checkbox"/> nucleotide and/or amino acid sequence listing in computer readable form 9. <input checked="" type="checkbox"/> other (specify): Transmittal		
Figure of the drawings which should accompany the abstract: Fig. 1		Language of filing of the international application: ENGLISH		
<b>Box No. IX SIGNATURE OF APPLICANT OR AGENT</b>				
Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).				
HUNTER DOUGLAS INC.		WENDELL B. COLSON		KEVIN DUNN
Name: _____		_____		_____
Title: _____		_____		_____

For receiving Office use only

1. Date of actual receipt of the purported international application:	2. Drawings:  <input type="checkbox"/> received:  <input type="checkbox"/> not received:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:	
4. Date of timely receipt of the required corrections under PCT Article 11(2):	
5. International Searching Authority (if two or more are competent): <b>ISA/EP</b>	6. <input type="checkbox"/> Transmittal of search copy delayed until search fee is paid

For International Bureau use only

Date of receipt of the record copy by the International Bureau:

For receiving Office use only

PCT

**FEE CALCULATION SHEET**  
Annex to the Request

International application No.

Applicant's or agent's  
file reference 4686/00002

Date stamp of the receiving  
Office

Applicant HUNTER DOUGLAS INC.

**CALCULATION OF PRESCRIBED FEES**

1. TRANSMITTAL FEE

240 | T

2. SEARCH FEE

925 | S

International search to be carried out by  
(If two or more International Searching Authorities are competent in relation to the international application, indicate the name of the Authority which is chosen to carry out the international search.)

3. INTERNATIONAL FEE

**Basic Fee**

The international application contains 136 sheets.

first 30 sheets

b<sub>1</sub> | 427

x 10.00 =

remaining sheets X additional amount

b<sub>2</sub> |

Add amounts entered at b<sub>1</sub> and b<sub>2</sub> and enter total at B

427 | B

**Designation Fees**

The international application contains 87 designations.

x 92.00 =

number of designation fees x amount of designation

736 | D

fee payable (maximum 8)

Add amounts entered at B and D and enter total at I  
(Applicants from certain States are entitled to a reduction of 75% of the international fee. Where the applicant is (or all applicants are) so entitled, the total to be entered at I is 25% of the sum of the amounts entered at B and D.)

1,163 | I

4. FEE FOR PRIORITY DOCUMENT (if applicable)

15 | P

5. TOTAL FEES PAYABLE

Add amounts entered at T, S, I and P,  
and enter total in the TOTAL box

**TOTAL: USD**  
**\$2,343.00**

☐ The designation fee is not paid at this time.

**MODE OF PAYMENT**

☒ authorization to charge  
deposit account (see below)

☐ bank draft

☐ coupons

☐ cheque

☐ cash

☐ other (specify):

☐ postal money order

☐ revenue stamps

**DEPOSIT ACCOUNT AUTHORIZATION** (this mode of payment may not be available at all receiving Offices)

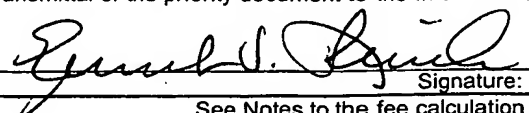
The RO/US ☒ is hereby authorized to charge the total fees indicated above to my deposit account.

☒ (this check-box may be marked only if the conditions for deposit accounts of the receiving Office so permit) is hereby authorized to charge any deficiency or credit any overpayment in the total fees indicated above to my deposit account.

☒ is hereby authorized to charge the fee for preparation and transmittal of the priority document to the International Bureau of WIPO to my deposit account.

19-0733  
Deposit Account Number

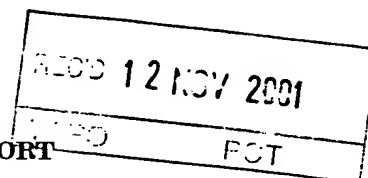
20 September 2000  
Date (day/month/year)

  
Signature:

# PCT

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)



Applicant's or agent's file reference 4686/00002	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/US00/25680	International filing date (day/month/year) 20 SEPTEMBER 2000	Priority date (day/month/year) 20 SEPTEMBER 1999
International Patent Classification (IPC) or national classification and IPC IPC(7): B32B 5/06 and US Cl.: 156/498, 555, 583.5		
Applicant HUNTER DOUGLAS INC.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 4 sheets.

☐ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority. (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of \_\_\_\_\_ sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of report with regard to novelty, inventive step or industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability, citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand  09 FEBRUARY 2001	Date of completion of this report  24 AUGUST 2001
Name and mailing address of the IPEA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231	Authorized officer  JAMES SELLS
Facsimile No. (703) 305-3230	Telephone No. (703) 308-0651

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/US00/25680

**I. Basis of the report****1. With regard to the elements of the international application: \***

- ☒ the international application as originally filed
- ☒ the description:
- pages 1-14 , as originally filed
- pages NONE , filed with the demand
- pages NONE , filed with the letter of \_\_\_\_\_

- ☒ the claims:
- pages 15-17 , as originally filed
- pages NONE , as amended (together with any statement) under Article 19
- pages NONE , filed with the demand
- pages NONE , filed with the letter of \_\_\_\_\_

- ☒ the drawings:
- pages 1-7 , as originally filed
- pages NONE , filed with the demand
- pages NONE , filed with the letter of \_\_\_\_\_

- ☒ the sequence listing part of the description:
- pages NONE , as originally filed
- pages NONE , filed with the demand
- pages NONE , filed with the letter of \_\_\_\_\_

**2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.**

These elements were available or furnished to this Authority in the following language \_\_\_\_\_ which is:

- ☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

**3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:**

- ☐ contained in the international application in printed form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

**4. ☒ The amendments have resulted in the cancellation of:**

- ☒ the description, pages NONE
- ☒ the claims, Nos. NONE
- ☒ the drawings, sheets/fig NONE

**5. ☐ This report has been drawn as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).\*\***

\* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

\*\*Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/US00/25680

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement****1. statement**

Novelty (N)	Claims	(Please See supplemental sheet)	YES
	Claims	(Please See supplemental sheet)	NO
Inventive Step (IS)	Claims	(Please See supplemental sheet)	YES
	Claims	(Please See supplemental sheet)	NO
Industrial Applicability (IA)	Claims	(Please See supplemental sheet)	YES
	Claims	(Please See supplemental sheet)	NO

**2. citations and explanations (Rule 70.7)**

Claims 1-3, 5-6, 8-10, 12-13 and 15-16 lack novelty under PCT Article 33(2) as being anticipated by Held (US Patent 5,352,321).

Held discloses a continuously operating double band press. As shown in Fig. 10, the press 53 comprises reversing drums 4-7 supporting endless press bands 8-9. The press further comprises fluid pressure plates 67 divided into heating plates 56 for heating zone 54 and cooling plates 57 for cooling zone 55. Heating plates 56 include bores 69 for receiving a heating fluid and cooling plates 57 include bores 70 for receiving a cooling fluid. Pressure is applied to fabric 12 via fluid in chamber 71 which is contained by floating seals 15.

Claims 4, 7, 11, 14 and 17-24 lack an inventive step under PCT Article 33(3) as being obvious over Held (US Patent 5,352,321) in view of Hartstein (US Patent 3,591,434).

Hartstein discloses a laminated non-woven fabric which is manufactured using a double belt press. The fabric comprises two non-woven yarns joined together by an adhesive film. As shown in Fig. 7, one yarn layer is oriented in the machine direction while the other yarn is oriented substantially perpendicular to the machine direction in the manner claimed by the applicant.

It would have been obvious to one having ordinary skill in the art to manufacture a non-woven fabric, as taught by Hartstein, in the apparatus of Held as a matter of design choice. In addition, steam and water are well known, conventional heat exchange fluids that would have been obvious to employ in the device of Held in order to facilitate heating and cooling of the press. Finally, the seal construction and pressure ranges claimed by the applicant are well known in the art and would have been obvious to employ in the device of Held based on the physical requirements of the materials being laminated.

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**NEW CITATIONS**

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US 5,352,321 A (HELD) 04 October 1994, see col. 3, lines 50-52 and col. 7, line 66 through col. 8, line 22.

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/US00/25680

**Supplemental Box**

(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: Boxes I - VIII

Sheet 10

**V. 1. REASONED STATEMENTS:**

The report as to Novelty was positive (YES) with respect to claims 4, 7, 11, 14 and 17-24.

The report as to Novelty was negative (NO) with respect to claims 1-3, 5-6, 8-10, 12-13 and 15-16.

The report as to Inventive Step was positive (YES) with respect to claims NONE.

The report as to Inventive Step was negative (NO) with respect to claims 1-24.

The report as to Industrial Applicability was positive (YES) with respect to claims 1-24.

The report as to Industrial Applicability was negative (NO) with respect to claims NONE.



PRESSURE LAMINATOR APPARATUS  
AND NON-WOVEN FABRIC FORMED THEREBY

CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority under 35 U.S.C. §119 from commonly owned provisional application, U.S.S.N. 60/155,364, filed 20 September 1999, the disclosure of which is hereby incorporated herein by reference.

FIELD OF THE INVENTION

This invention relates to a lamination apparatus and in particular to a dual belt driven, continuous pressure lamination apparatus that utilizes pressure, heat and cooling to bond at least two substrates (plies) with an adhesive between the layers of the substrates. The laminator of the present invention overcomes many of the disadvantages of prior art laminators, including shrinkage of materials, and the like.

SUMMARY OF THE INVENTION

This invention relates to a lamination apparatus and in particular to a dual belt driven, continuous pressure lamination apparatus that utilizes pressure, heat and cooling to bond at least two substrates (plies) with an adhesive between the layers of the substrates.

The laminator of the present invention can be employed to make a variety of composite and/or reinforced materials. One or more of the component parts of the laminate (i.e., the substrates or plies) may be a woven fabric material, a non-woven fabric web, or a mat of fibers. Adhesive materials, preferably thermoplastic materials, are used to bond the various substrates in the laminate construct. These materials may be melted and remelted over and over. When used to laminate yarns, especially polymer yarns, thermoplastic copolyester adhesives are preferred, as these materials may be selected to have a melting temperature below the melting temperature of the yarns. Industrial type laminates that may be formed using the laminator of the present invention include natural and/or synthetic fabric-based, asbestos-based, glass-based, nylon-based, flame-retardant and/or flame-resistant based, and mixtures thereof. Laminates of other materials may also be prepared as will be appreciated by those having ordinary skill in the field.

Non-woven fabrics are one especially preferred class of materials used as the plies or substrates in the pressure laminator of the present invention. Non-woven fabrics are similar to woven and knitted fabrics in that all are planar, inherently flexible, porous structures composed of natural or synthetic fiber materials (i.e., yarns, threads, or filaments). Non-woven fabrics are unique in that they can be engineered to resemble woven or knitted fabrics, but they can also be made to have superior physical characteristics over woven or knitted fabrics. Thus, non-woven fabrics are highly influenced by the properties of their constituent fibers and the manner in which the non-woven fabric is prepared. Typical methods for preparing non-woven fabrics include mechanical, chemical and thermal interlocking of layers or networks of the fiber materials.

In preferred embodiments, the substrates are at least two non-woven fabric substrates, one of the fabric substrate representing the weft strands and another representing the warp strands. The adhesive used to bond the non-woven substrates should be activated by heat during the lamination process. The combination of pressure, heating to activate the adhesive and rapid cooling

of the joined substrates minimizes shrinkage and sets the yarn size in the final non-woven fabric laminate. In addition, because the laminate is being formed under pressure, the warp and weft yarns are forced into intimate contact, giving the final laminate the appearance of a woven product.

The lamination apparatus of the present invention has an outer housing or frame in which a rectangular pressure box is mounted. The shape of the box need not be rectangular, but this shape is currently preferred. The pressure box comprises two spaced apart sections, an upper section and a lower section, each of which has pressure seals along its four edges, and each of which is further provided with a plurality of both heating and cooling elements. Two counter rotating drive belts, an upper drive belt and a lower drive belt, contact one another at and together run through a space between the two sections of the pressure box. The belts are dimensionally larger (length and width) than the pressure box. This is necessary to permit pressurization of the box, both above and below the two belts. One belt is driven in a clockwise manner and the other belt is driven in a counterclockwise manner. Once the belts are in motion, one end of the pressure box is the inlet (feed) end and one end is the outlet end of the laminator.

The lower section of the pressure box is mounted rigidly to the frame or housing, whereas the upper section of the pressure box can be adjusted as necessary to permit access to the interior of the box. Normally, the sections are spaced apart sufficiently to permit passage of the drive belts there through under pressure (or in a depressurized state), with or without material to be laminated there between.

During the lamination process, substrate materials to be laminated are passed through a pressure seal at the inlet end of the pressure box, and into the space between the two drive belts. Air pressure applied to the upper and lower sections of the pressure box is used to compress the air-impermeable belts toward one another, creating a diaphragm effect between the belts, thereby compressing the substrates situated there between. The upper and lower

- 4 -

sections of the pressure box are equipped with a plurality of heating and cooling elements, which are used to activate and set the thermoplastic adhesive between the substrate layers.

In an especially preferred embodiment, the plurality of heating and cooling bars located in the lower section of the pressure box are rigidly mounted, whereas the plurality of heating and cooling bars in the upper section of the pressure box are mounted so as to float on top of the materials being laminated.

This arrangement has been found to be especially useful in the preparation of non-woven fabrics. Shrinkage is minimized or eliminated and the final laminate has the physical characteristics (feel and appearance) of a thermomechanically finished fabric.

Advantageously, at least about 10%, preferably at least about 25% and most preferably about 50% of the box interior at the inlet end of the pressure box is provided with heat bars, and the remainder of the pressure box, again, at least about 10%, preferably at least about 25% and most preferably about 50% of the box interior, is provided with cooling bars. The heating bars are ideally located at the inlet end of the pressure box and the cooling bars are ideally located at the outlet end of the pressure box. If desired, multiple zones of heating and cooling could be included within the pressure box; e.g., heat/cool, heat/cool, heat/cool, etc.

Movement of the two belts through the pressure box allows for the continuous feeding of substrate materials and thermoplastic adhesive enter the laminator through an entry pressure seal. Once therein, the substrates are nipped or pressed together by the diaphragm effect caused by the pressure applied to the belts. The pressed substrates are then heated under pressure, melting the thermoplastic adhesive. This allows the substrate layers to come closer together, with at least some portions of the warp and weft yarn strands becoming coplanar or nearly coplanar. The heated substrates are then cooled, while still under pressure, forming the final laminate. The cooled laminate exits the pressure box through an exit pressure seal, where it is collected as desired.

- 5 -

When two or more non-woven polyester substrates (e.g., at least one warp substrate and at least one weft substrate) are laminated in this apparatus, the thickness of the laminate at the outlet end of the laminator is at least 5%, preferably at least 10% and most preferably at least about 20% less than the combined thickness of the substrates and thermoplastic adhesive, as measured at the inlet end of the laminator.

The current rectangular pressure has a pressure area about 1500 square inches (in<sup>2</sup>). The drive belts, which are substantially non-porous, are pressurized from both sides of the pressure box with air (or other fluid medium) pressure of at least 2 psi, preferably at least about 5 psi, and most preferably at least about 10 psi. Higher pressures can be achieved with modification of the equipment to support and sustain the same. This pressure applied to the belts is equivalent to a compressive weight (force) ranging from about 5000 lbs to about 50,000 lbs, applied over the 1500 in<sup>2</sup> area of the current pressure box. For laminating non-woven fabrics, a compressive force from about 10,000 lbs to about 25,000 lbs is typical, and a compressive force of about 15,000 lbs (at 10 psi gauge) has been found to be especially preferred to date. This is important because in a traditional laminator, which uses top and bottom platens, if a weight of 15,000 lbs was placed on the top platen to provide the compressive force to effect lamination, any belt running hereunder would likely break. Traditional high pressure laminators usually employ a series of actions; move, stop, press; move, stop, press; etc., when operating in a "continuous" manner.

In the present invention, the use of a fluid pressure medium, e.g., air (or other gas, e.g., steam) or liquid (e.g., water, oil, etc), allows the belts to move, even though being pressured from both the top and the bottom. The belts of the present laminator slide through, even though they encounter forces that would break a belt in a conventional laminator.

This invention is also directed to a method of manufacturing non-woven fabrics using the pressure lamination apparatus, and to the non-woven fabrics formed thereby. The pressure laminator of the present invention has been

- 6 -

specifically designed to permit the permanent joining of at least two non-woven fabric substrates with an adhesive between the fabric substrates, with little or no shrinkage occurring, during the lamination process. While not wishing to be bound by theory, it is believed that shrinkage is prevented or limited herein, due to the high pressure on the belts, which prevents the laminate from slipping, thereby preventing or limiting shrinkage. The resulting non-woven composite fabric advantageously has the appearance of a woven fabric, but has superior strength characteristics there over.

While designed for a specific purpose, the pressure laminator of the present invention can have other uses, for example, printed circuit board substrate manufacture, decorative laminating, industrial laminating, and the like, as will be appreciated by those having ordinary skill in this art.

#### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view of a preferred embodiment of the pressure box and drive belt system for the laminator of the invention in which eight heater bars (four in each section) and eight cooling bars (four in each section) are used for pressure lamination of non-woven fabric substrates;

FIG. 2 is an end view of the pressure box of Figure 1, which shows the pressure delivery system for the upper and lower sections of the pressure box;

FIG. 3 is a top view of the upper section of the pressure box of Figure 1, showing the spacing of the heating and cooling bars;

FIG. 4 is a side view of the pressure box of Figure 1, showing the mounting brackets for the upper section (displaceable) heating and cooling bars and the mounting brackets for the lower section (fixed) heating and cooling bars. Also shown is one embodiment of a side sealing element;

FIG. 4A illustrates the side pressure seal of FIG. 4 in greater detail.

- 7 -

FIG. 5 is a side view of the pressure box of Figure 1, showing one embodiment of the pressure box inlet pressure seal element; and

FIG. 6 is a side view of the pressure box of Figure 1, showing one embodiment of the pressure box outlet pressure seal.

FIGS. 7A, 7B and 7C illustrate aspects of the inflatable rubber bladder seal embodiment for the pressure box sections.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

As described above, the present invention is directed to a lamination apparatus and in particular to a dual belt driven, continuous pressure lamination apparatus that utilizes pressure, heat and cooling to bond at least two substrates (plies) with an adhesive between the layers of the substrates. If desired, the laminator of the present invention could also be used to stabilize a single ply material.

In general, the pressure lamination apparatus of this invention comprises a housing or frame in which a pressure box is mounted. The pressure box comprises two spaced apart pressure sections, an upper section and a lower section, wherein the space formed between the two pressure sections defines the lamination section. Two counter rotating drive belts, an upper drive belt and a lower drive belt, are rotatably mounted in the housing or frame, and the belts contact one another and are pulled through the lamination section by drive rollers mounted at the outlet end. A pressure generator is used to supplying air (or other fluid medium - liquid or gas) pressure to the upper and lower sections of the pressure box for compressing substrate materials carried between the two drive belts. Pressure is maintained because the box has pressure seals all around the points of contact with the belt.

In the rectangular box of one preferred embodiment, metal side seals are provided on the sides of both the upper and lower sections of the pressure box.

Metal inlet and outlet seals are also provided on the upper and lower sections of the pressure box, ensuring that the desired diaphragm effect can be created therein. When pressurized, the apparatus caused the pressure lamination of substrates situated between the two belts.

In the rectangular box of another preferred embodiment, Teflon® (PTFE) or rubber coated metal side seals are provided on the sides of both the upper and lower sections of the pressure box. Rubber inlet and outlet seals are also provided on the upper and lower sections of the pressure box, ensuring that the desired diaphragm effect can be created therein. When pressurized, the apparatus caused the pressure lamination of substrates situated between the two belts.

Referring to FIG. 1, a number of the essential components of the preferred pressure box 1 used in the pressure laminator of the present invention are shown in cross-section. As illustrated, two rotatable belts, top belt 2 and bottom belt 4, mounted on a plurality of support rollers (top - 110, 120, 130; bottom - 210, 220, 230), are pulled through the pressure box 1, between the upper section 12 and the lower section 14, entering at the inlet end 16 and exiting at the outlet end 18, by their respective drive rollers 150 (top) and 250 (bottom).

Alignment of the two rotating belts 2 and 4, is maintained by an electric alignment system comprising an alignment carriage 300, alignment pivot 310, electric alignment servo 320 and electric alignment eye 330. If either of the belts moves out of alignment, the electric eye 330 detects the same and activates the alignment servo, which causes the belt to be adjusted as necessary by lateral movement of the alignment carriage 300.

In the illustrated embodiment, eight spaced apart radiant heat bars (10A, 10B, 10C, 10D ... 10H) are shown at the inlet end 16 of pressure box 1 and eight spaced apart cooling bars (20A, 20B, 20C, 20D ... 20H) are shown at the outlet end 18 of pressure box 1. Four of the heat bars are rigidly mounted in the



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lower section 14 of the pressure box 1, namely heat bars 10A, 10C, 10E and 10G. The other four radiant heat bars (10B, 10D, 10F and 10H) are flexibly mounted such that they float above the upper belt, permitting materials of varied thickness to pass there under. Four of the cooling bars are rigidly mounted in the lower section 14 of the pressure box 1, namely cooling bars 20A, 20C, 20E and 20G. The other four cooling bars (20B, 20D, 20F and 20H) are flexibly mounted such that they float above the upper belt, permitting materials of varied thickness to pass there under.

As illustrated, the plurality of heating and cooling bars are preferably arranged in a staggered configuration. Thus, the substrate is heated from below, then above, then below, etc., and the cooling is accomplished in the same manner; the substrate is cooled from below, then above, then below, etc. This arrangement permits rapid and uniform heating, as well as rapid and uniform cooling of the substrate materials being laminated in the pressure laminator. The uniformity of heating and cooling under pressure leads to improved physical characteristics of the resulting laminates. In the case of non-woven fabrics laminated in this manner, shrinkage of the fabrics is held to a minimum and the resulting laminated material has the appearance and feel of a woven fabric.

In one embodiment, at least 75 percent of the belt width is heated and cooled by these elements. For example, on a 29-inch wide belt, the central 22 inches are heated and cooled. On a 76-inch wide belt, the central 60 inches would be heated and cooled. The Reliant ER177A heat bars (England) are each provided with a thermocouple to measure the temperature delivered to the belts. The cooling bars are each provided with water fed cooling pipes.

In another embodiment, the heating and cooling is accomplished by steam and cold water; each fed to an appropriate section of the laminator, in both the upper and lower sections. The use of a high-pressure gas and fluid medium creates both pressure and the requisite heating/cooling action that was alternatively achieved by the heating and cooling bars together with high-pressure air. If desired, infra-red heating may also be employed in this

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embodiment, and cooling may be accomplished by other means, including water spray, providing non-contact heating and/or cooling options.

The thickness of the PTFE impregnated fiberglass belt can be modified as desired, and depends on the nature of the materials being laminated and the desired operating speed in feet per minute (fpm). For laminating non-woven fabrics, a belt thickness ranging from 2 to 20 mil, preferably 5 to 15 mil has been found satisfactory. Belts of 14-mil thickness have been operated at 5 fpm, with a temperature of 380°F being delivered to the substrates. Belts of 5-mil thickness have been operated at 12 fpm, with a temperature of 380°F being delivered to the substrates. Optimum belt speeds of 50, 60, 70 ... 100 fpm can be achieved by modification of the belt thickness and/or composition. The optimum belt speed for non-woven fabric lamination is currently believed to be 60-70 fpm. Another way in which to achieve higher speeds is to simply increase the size of the laminator apparatus. The current preferred apparatus has a length of about 4 feet. Increasing the size 2-10X would allow for faster operating speeds.

During the lamination process the substrate material may create a counter-pressure as any entrapped air in the substrates expands. To deal with this counter-pressure, at least one (or both) of the PTFE (Teflon®) impregnated fiberglass drive belts used in the pressure laminator of the present invention can be modified on the outside edges, to comprise a thick (about 0.125 inch) porous glass fiber mat. This porous glass fiber mat allows the expanded air from the heated laminate to escape via this sideways (transverse) porosity.

Figure 2 illustrates in cross-section, the end view of pressure box 1, showing in particular the air pressure feed line 400, and the preferred points of contact thereof 402 and 404 with the upper section 12 and lower section 14 of the pressure box, respectively. The pressure box is advantageously made out of metal, such as aluminum (from 2 to 5 inches thick) and is held together by a plurality of threaded steel rods and nuts 406 and 408. As shown in Fig. 2, the heating and cooling bars located in the lower section 14 of the pressure box are

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locked in place at each end by a fixed bracket 410. The heating and cooling bars located in the upper section 12 of the pressure box ride on a pin bracket mount 412, which allows upward motion of the bars, while gravity keeps the bars resting on the upper belt. A plurality of cooling water lines, inlet 414 and outlet 416 are also shown in this illustration. The electrical heating wires (not shown) are provided in a manner similar to the water lines.

Figure 3 illustrates a top view of the interior of the upper section 12 of the pressure box 1, showing the currently preferred arrangement of the upper heating bars (10B, 10D, 10F and 10H) and cooling bars (20B, 20D, 20F and 20H). The pressurized box 1 is held together by steel bars 500 mounted to the threaded rods 406 shown in the four corners. Not shown in this illustration are the nuts that thread thereon. The sides 2 of the housing or frame, to which the steel bars and all rollers and controls are mounted, are also shown in this drawing.

Figure 4 illustrates, the pin bracket 412 for the upper section, vertically displaceable, heating and cooling bars. As illustrated, the pin bracket comprises a steel mounting bracket 600, fixed at one end to the aluminum side wall of the upper section 12 of the pressure box. A slot (not shown) is provided near the opposite end of bracket 600, through which a post 610 rides. The post 610 is mounted to the top of the heating or cooling bar at one end and capped at the opposite end 612, thereby limiting the vertical displacement distance of the heating and cooling bars. The bracket for the lower section heating and cooling bars 620 is also a steel bracket, but it is rigidly attached to both the heating and cooling bars and the aluminum side wall of the lower section 14 of the pressure box.

A side pressure seal 650 is illustrated in FIG. 4 and illustrated in greater detail in Figure 4A. This seal is formed from a high temper curved aluminum slat 700 (e.g., 0.008 x 1 3/8" - Venetian blind) sandwiched between 2 mil PTFE (Teflon®) tape 710 on the upper side and 10 mil ultrahigh molecular weight polyethylene tape 720 on the bottom side. The seal is held in place by a steel

bracket 670.

As illustrated in Figures 5 and 6, it has been discovered that the aluminum pressure seal taught in Figure 4A can be simplified, such that the side and inlet pressure seals consists predominantly of the curved aluminum slat 700 as previously described. The ultrahigh molecular weight polyethylene tape can be omitted and the PTFE tape can be omitted, except in the corners of the pressure box, where the tapes still prove useful. This improved side seal and inlet pressure seal is illustrated in Figure 5.

The exit pressure seal is shown in Figure 6. In addition to the curved aluminum slat 700, the belt side of the aluminum slat is coated with 5 mil PTFE (Teflon®) fiberglass cloth 800, which extends beyond the end of the aluminum seal and mounts to the inside of the pressure box frame. This exit seal design keeps the drive belt from binding on the aluminum slat.

As discussed above, one may also replace these metal seals or more inflatable rubber bladders, which offer several advantages not provided by the above-described metal seals. See Figures 7A, 7B and 7C, which depict the positioning of one inflatable bladder 200 (e.g., silicone rubber) on the peripheral edges of the pressure box (Fig. 7A); the bladder 200 as inflated with the Teflon coated metal slip plate 210 (Fig. 7B); and the bladder 200 as partially deformed via belt contact (Fig. 7C) creating the desired seal for the pressure box. A channel 220 is provided in the frame of the pressure box wall for attachment of the rubber bladder (Fig. 7C). An inflatable bladder of this type is used for both the upper and the lower portions of the pressure box.

As the bladders are inflated against the belts, a uniform sealing pressure is created around the periphery of the pressure box. This contrasts with the all-metal seal embodiment, in that the pressure applied to the belts is much more uniform and constant. Also, the bladder sealing effect is much more efficient; as the bladder is provided with a slip-seal surface comprising a metal strip coated with Teflon. This surface directly contacts the belts and allows for smooth

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running of the same. Direct contact between the belts and the rubber bladder is thus avoided. In the all-metal seal embodiment, a portion of the sealing pressure is contributed by the weight of the floating heating and cooling bars, and leakage of the seals can occur, particularly at the inlet and outlet ends of the laminator.

As described above, this invention is also directed to a method of manufacturing non-woven fabrics using the preferred pressure lamination apparatus, and to the non-woven fabrics formed thereby.

PCT Publication No. WO 00/41523 describes a non-woven warp yarn fabric material, which is one preferred substrate for lamination in the present invention. In general, the PCT Publication describes one preferred substrate for use in the pressure laminator of the present invention. The substrate of the PCT Publication comprises a plurality of yarns that are formed into an aligned group, substantially parallel and equally spaced apart, and held together by a hot melt adhesive applied to one side of the fiber group. This fiber orientation, in which the fibers run in the machine direction, creates a non-woven fabric material substrate in which the fibers mimic warp yarns, which can be combined with one or more woven or non-woven fiber substrates and pressure laminated to create finished products that have the visual impression and physical feel of a woven material.

PCT Publication No. WO 00/41523 also describes the formation of a preferred substrate material used in the pressure laminator of the present invention. In general, the PCT Publication describes an apparatus for fabricating a non-woven fabric composite, which has the appearance of a woven fabric. The apparatus includes a supply station for adhesive coated parallel warp yarns, a support structure for orienting the parallel warp yarns into a cylindrical orientation with the adhesive film on the outside, a weft yarn applicator for wrapping weft yarns around the cylindrically oriented warp yarns, a heating station for activating the adhesive and a cooling station for setting the adhesive, and a cutter for severing the cylindrically formed fabric composite so

that it can be flattened and wrapped onto a take-up roller, for transfer to the pressure laminator of the present invention.

The weft yarn applicator disclosed in the PCT Publication includes a rotating drum wherein a plurality of spools of weft yarn material are mounted in circumferentially spaced relationship and a tensioner is provided for applying the weft yarn material around the warp yarns in a predetermined tension which may be the same as, greater than, or less than the tension in the warp yarns. A conical aligner assures that the weft yarns will be delivered to the warp yarn cylinder in substantially perpendicular alignment.

PCT Publication No. WO 00/41523 designates the United States and as such, the disclosure of that publication is hereby incorporated herein by reference.

The present invention has been described in detail, including the preferred embodiments thereof. However, it will be appreciated that those skilled in the art, upon consideration of the present disclosure, may make modifications and/or improvements on this invention and still be within the scope and spirit of this invention as set forth in the following claims.

## WHAT IS CLAIMED IS:

1. A pressure lamination apparatus comprising:
  - (a) a housing or frame in which a pressure box is mounted;
  - (b) said pressure box comprising two spaced apart pressurizable sections, an upper section and a lower section, wherein the space formed between the two sections defines a lamination section;
  - (c) two counter rotating drive belts, an upper drive belt and a lower drive belt, rotatably mounted in said housing or frame, wherein said belts contact one another at and pass in the same direction through the lamination section;
  - (d) a fluid medium pressure generator for supplying pressure to the upper and lower sections of the pressure box for compressing said drive belts moving there between; and
  - (e) whereby, depending upon the direction of rotation of said belts, one end of the lamination section acts as an inlet for substrates to be laminated and the opposite end acts as an outlet for pressure laminated materials.
2. The pressure lamination apparatus of claim 1, wherein the upper section of the pressure box further comprises a heat source.
3. The pressure lamination apparatus of claim 2, wherein the heat source comprises a plurality of heating elements.
4. The pressure lamination apparatus of claim 2, wherein the heat source comprises a steam powered heating section.
5. The pressure lamination apparatus of claim 1, wherein the upper section of the pressure box further comprises a cooling source.
6. The pressure lamination apparatus of claim 5, wherein the cooling source comprises a plurality of cooling elements.

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7. The pressure lamination apparatus of claim 5, wherein the cooling source comprises a cold water cooling section.

8. The pressure lamination apparatus of claim 1, wherein the lower section of the pressure box further comprises a heat source.

9. The pressure lamination apparatus of claim 8, wherein the heat source comprises a plurality of heating elements.

10. The pressure lamination apparatus of claim 9, wherein the lower heating elements are fixed in place.

11. The pressure lamination apparatus of claim 8, wherein the heat source comprises a steam powered heating section.

12. The pressure lamination apparatus of claim 1, wherein the lower section of the pressure box further comprises a cooling source.

13. The pressure lamination apparatus of claim 12, wherein the cooling source comprises a plurality of cooling elements.

14. The pressure lamination apparatus of claim 12, wherein the cooling source comprises a cold water cooling section.

15. The pressure lamination apparatus of claim 13, wherein the lower cooling elements are fixed in place.

16. The pressure lamination apparatus of claim 1, wherein lower section of the pressure box is mounted rigidly to the frame or housing.

17. The pressure lamination apparatus of claim 1, wherein the upper section of the pressure box is mounted to the frame in an adjustable manner.



18. The pressure lamination apparatus of claim 1, wherein the pressure box sections further comprise pressure seals at the sides and the inlet and outlet ends of the lamination section.

19. The pressure lamination apparatus of claim 18, wherein the pressure seals comprise metal.

20. The pressure lamination apparatus of claim 18, wherein the pressure seals comprise one or more rubber bladders.

21. The pressure lamination apparatus of claim 18, wherein the drive belts are pressurized within a range of from about 5000 lbs to about 50,000 lbs, over an area of about 1500 in<sup>2</sup>.

22. The pressure lamination apparatus of claim 18, wherein the drive belts are pressurized within a range of from about 10,000 lbs to about 25,000 lbs, over an area of about 1500 in<sup>2</sup>.

23. The pressure lamination apparatus of claim 18, wherein the drive belts are pressurized at about 15,000 lbs over an area of about 1500 in<sup>2</sup> or 10 psi.

24. A laminated non-woven fabric formed in the apparatus of claim 1, said laminated fabric comprising:

a first non-woven layer and a second non-woven layer laminated to one another to form a laminated composite fabric;

said first non-woven layer having yarns aligned in the machine direction;

said second non-woven layer having yarns aligned substantially perpendicular to the machine direction;

said laminated composite fabric further including a film of adhesive disposed between the first and second non-woven layers.

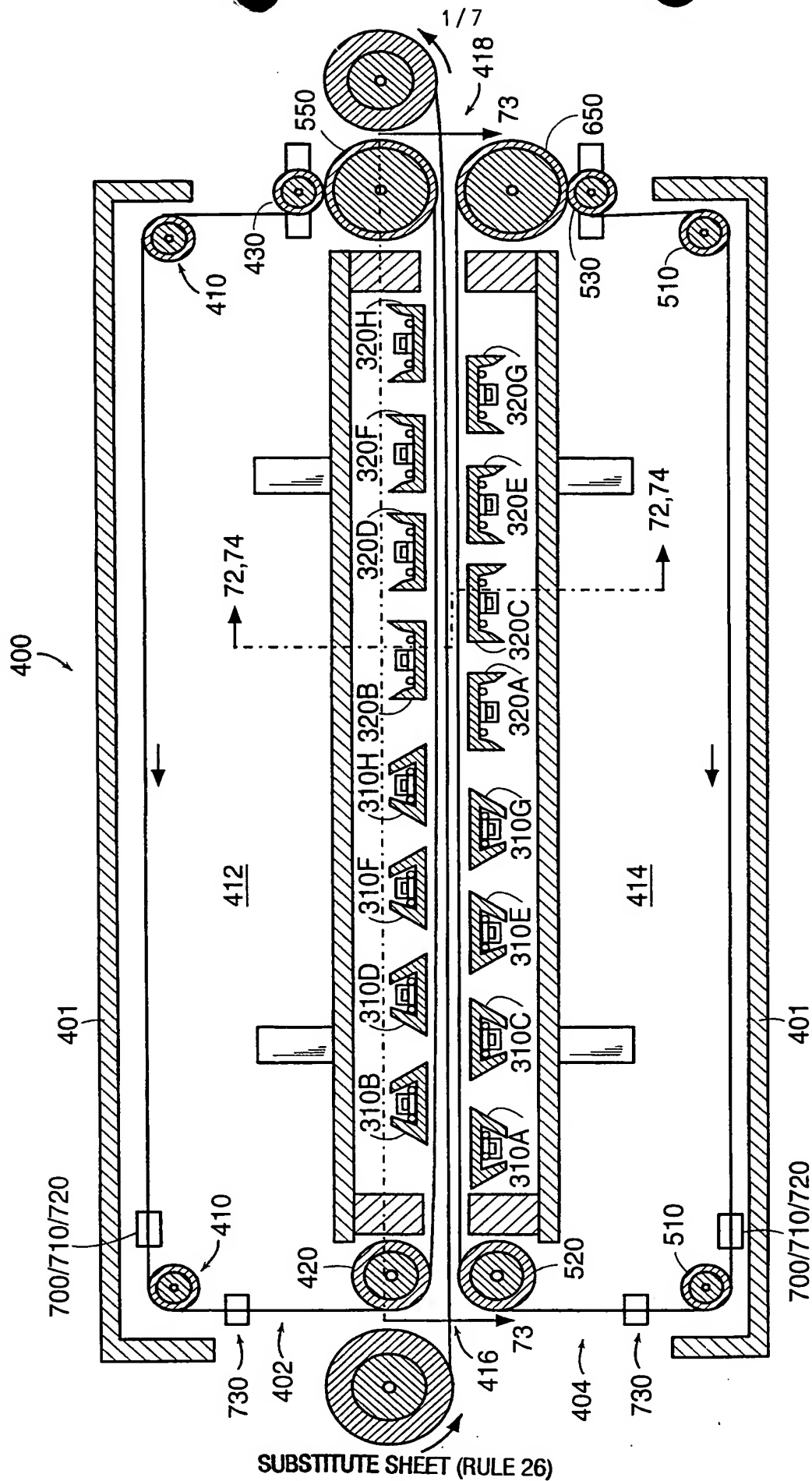


FIG. 1

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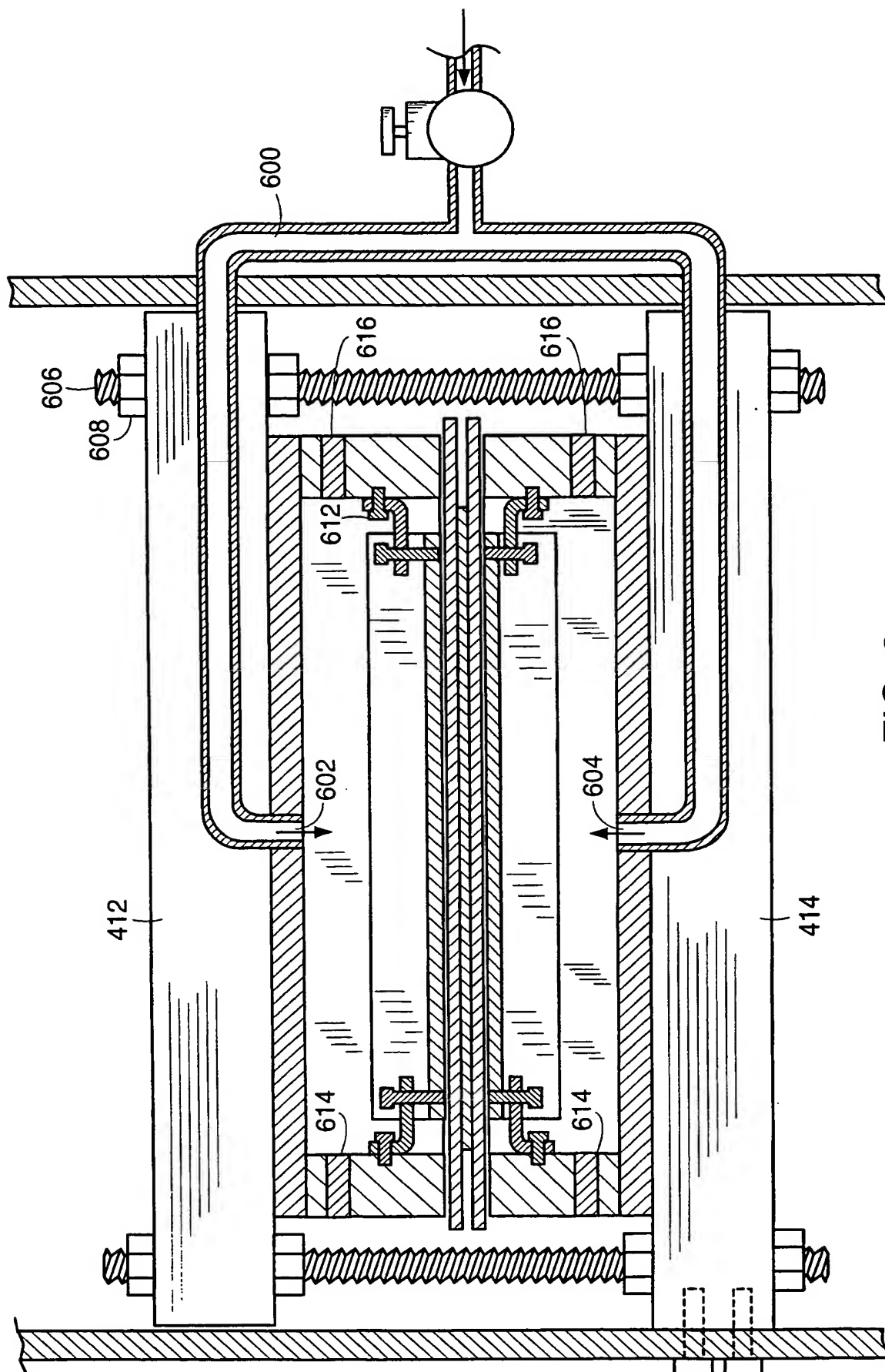
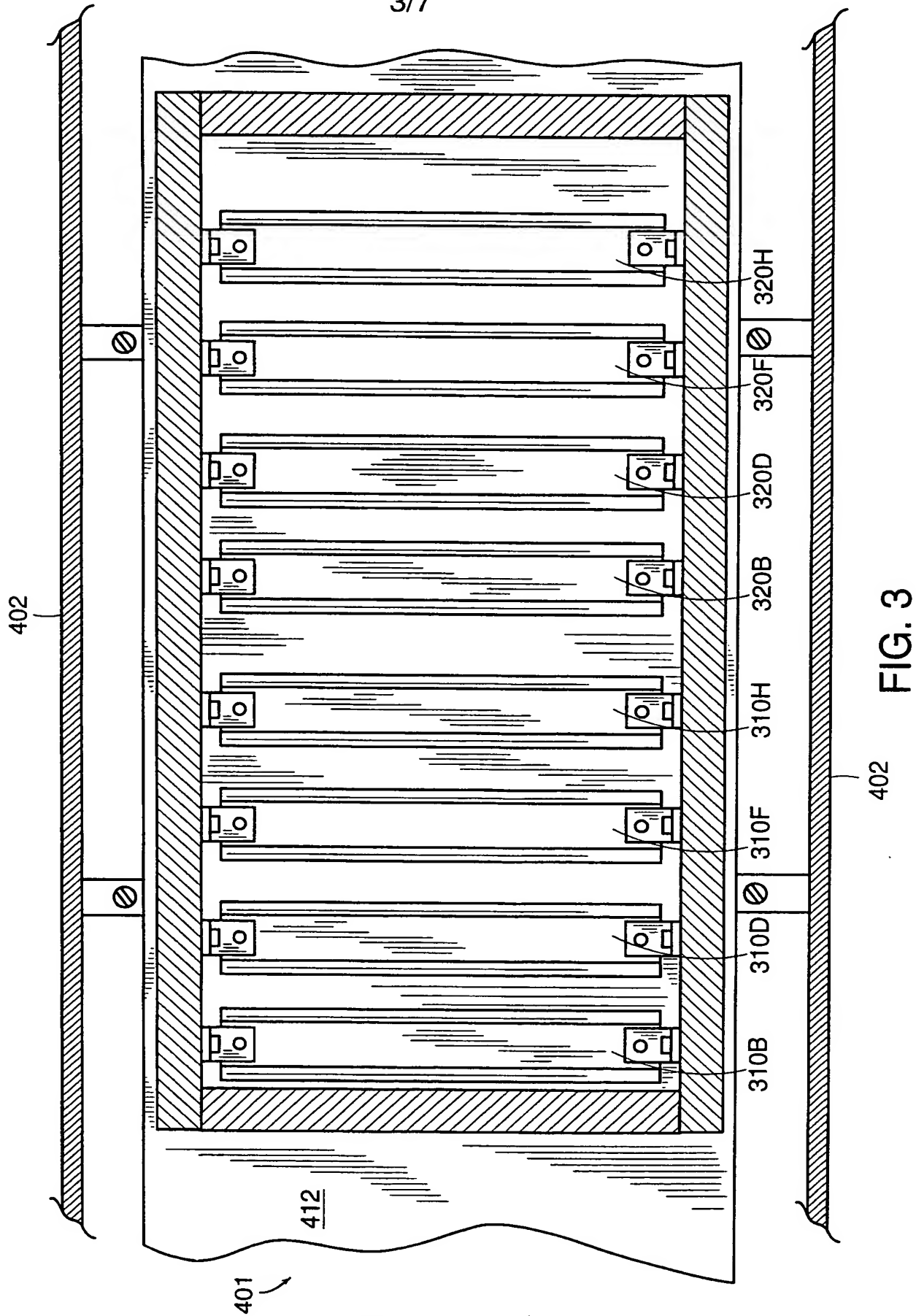


FIG. 2

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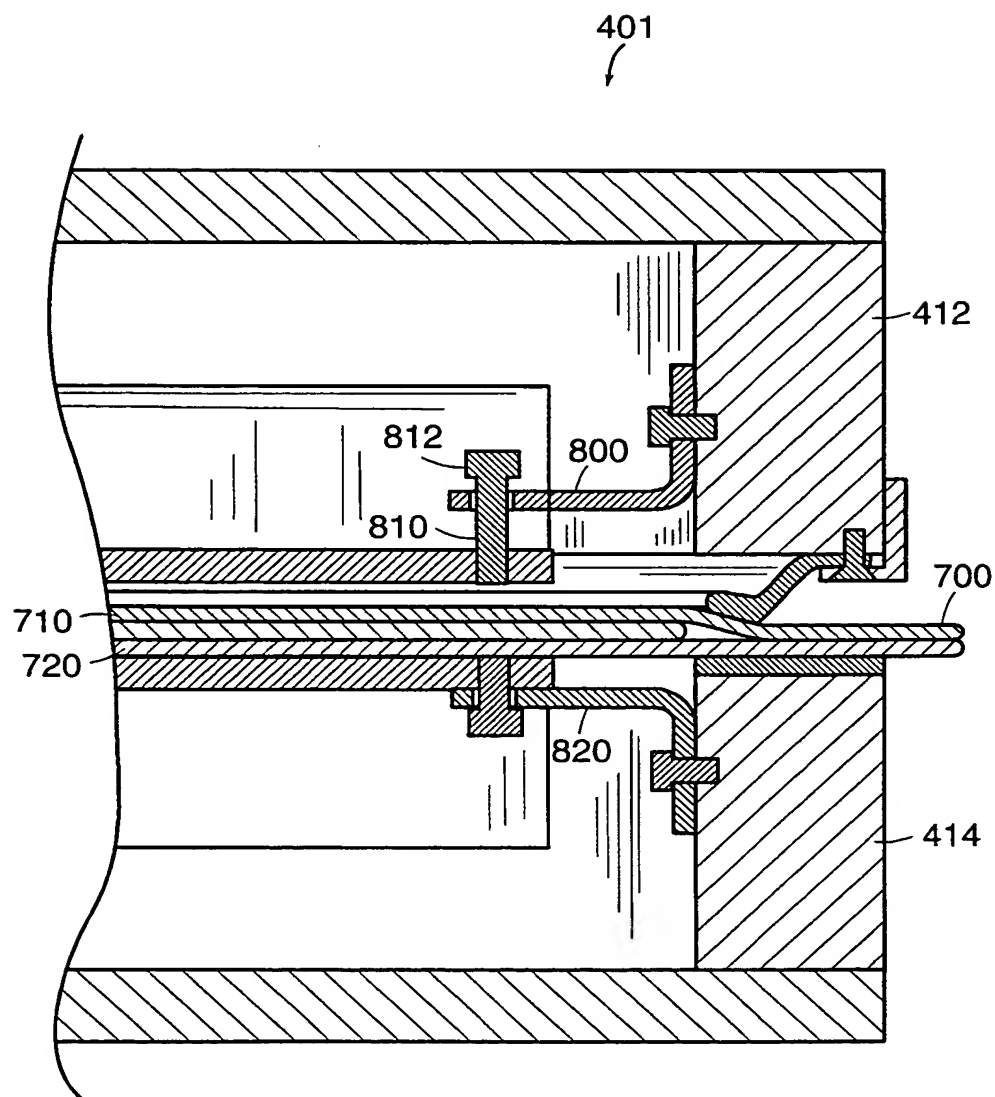


FIG. 4

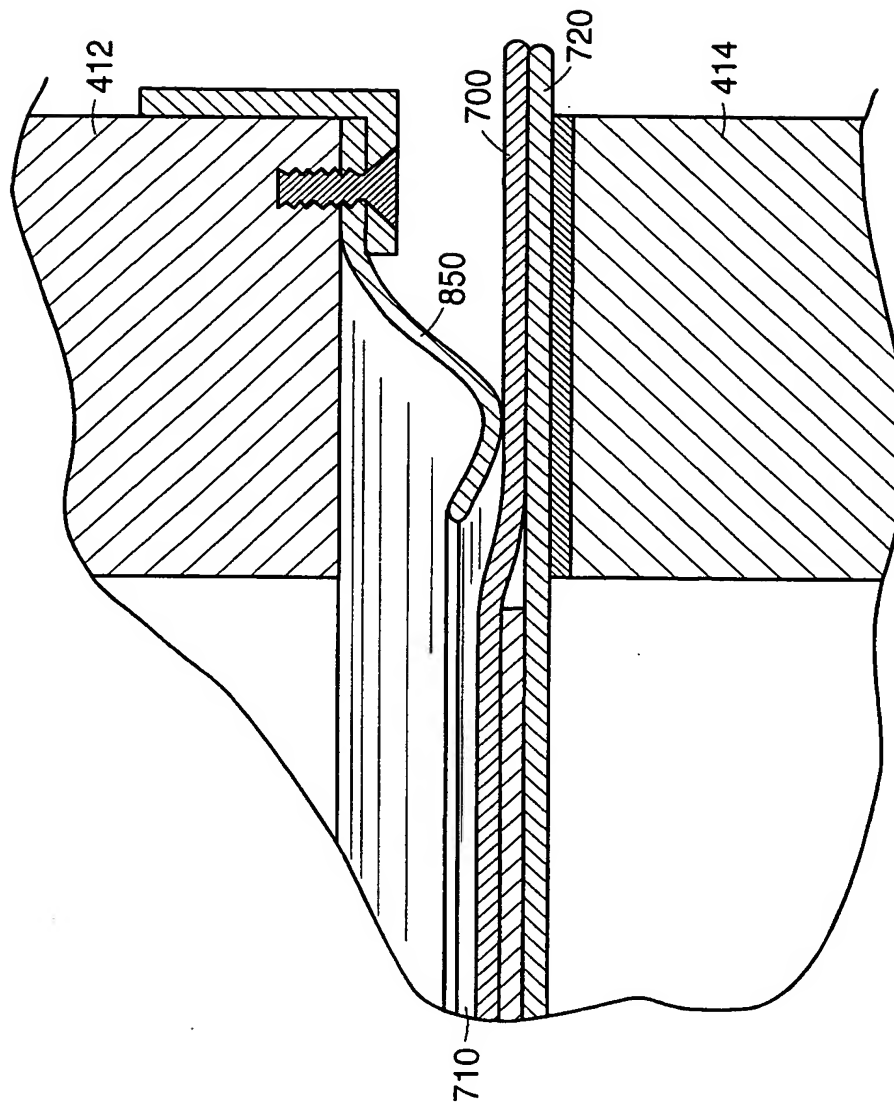


FIG. 5



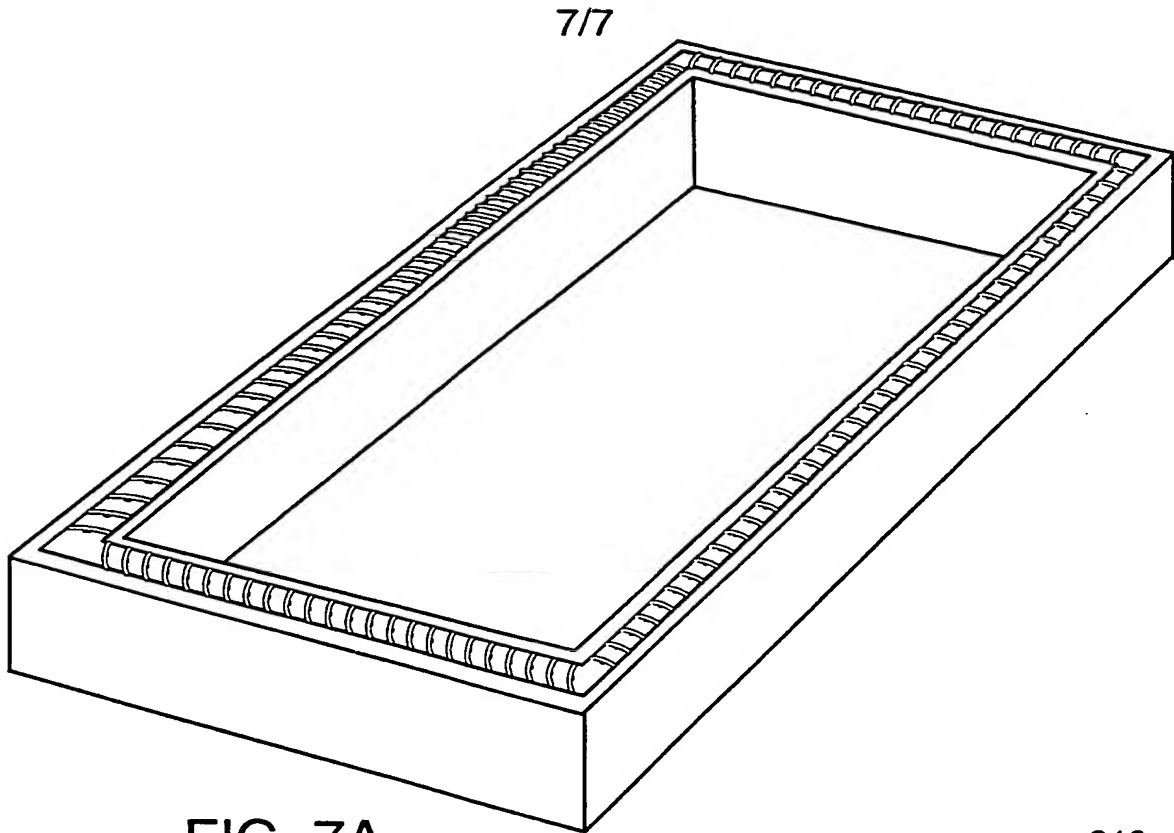


FIG. 7A

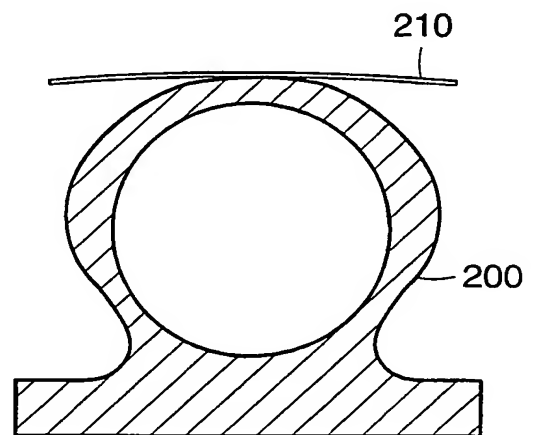


FIG. 7B

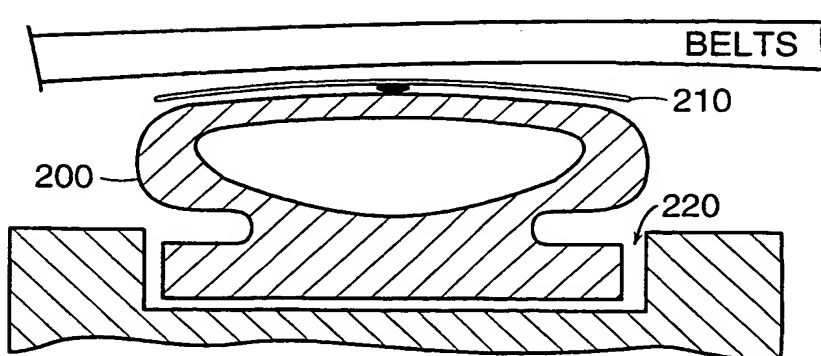


FIG. 7C

SUBSTITUTE SHEET (RULE 26)



# INTERNATIONAL SEARCH REPORT

In. Application No  
PCT/US 00/25680

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 B32B31/00 B30B5/06 D04H3/04

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B32B B30B D04H B29C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 01 210318 A (MITSUBISHI RAYON ENG CO LTD) 23 August 1989 (1989-08-23) figures	1, 16, 18
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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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- \*Z\* document member of the same patent family

Date of the actual completion of the international search

22 January 2001

Date of mailing of the international search report

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Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Barathe, R

# INTERNATIONAL SEARCH REPORT

In International Application No

PCT/US 00/25680

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